

# PATENT ABSTRACTS OF JAPAN

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## (54) DISK READ/WRITE CONTROL PROGRAM

### (57)Abstract:

PROBLEM TO BE SOLVED: To eliminate verification processing during write by lowering an uncorrectable error occurrence probability during the read-out of data from a disk unit.

SOLUTION: This disk read/write control program manages prescribed n-piece of data sector in one group as a unit (sector) of prescribed L-byte of data, and makes a computer carry out the write and read of a storage medium. This program makes the computer function as a parity generating means which forms m-piece of parity sector consisting of L-byte by repeating processing to generate m-byte of error detection correction code to n-byte of data formed by extracting 1 byte from the data sector of the same group for all L-byte of data, and a read/write control means which distributes the n-piece of data sector of the same group and the corresponding m-piece of parity sector as one parity group and writes them into the storage medium so that sectors belonging to the same parity group are not adjoined with each other.

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## CLAIMS

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[Claim(s)]

[Claim 1] It is the disk R/W control program which the data sector of n predetermined numbers is managed [ control program ] as one group by making data with a predetermined number of L bytes into a unit (sector), and makes a computer perform the writing and read-out to a storage. The processing which generates m bytes of error detection correction sign to n bytes of data which extracted every 1 byte each of computer from the same group's data sector is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, n data sectors of the same group and m corresponding parity sectors as one parity group The disk

R/W control program for making it function as an R/W control means which distributes so that the sector belonging to the same parity group may not adjoin physically mutually, and is written in a storage.

[Claim 2] It is the disk R/W control unit which manages the data sector of n predetermined numbers as one group by making data with a predetermined number of L bytes into a unit (sector), and performs the writing and read-out to a storage. The processing which generates m bytes of error detection correction sign to n bytes of data extracted from the same group's data sector every 1 byte each is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, n data sectors of the same group and m corresponding parity sectors as one parity group The disk R/W control unit characterized by having the R/W control means which distributes so that the sector belonging to the same parity group may not adjoin physically mutually, and is written in a storage.

[Claim 3] It is the disk R/W control program characterized by being the disk R/W control program which reads the data written in using the disk R/W control program according to claim 1, for an R/W control means reading a parity sector when the error which cannot be corrected within a sector at the time of data sector read-out is detected, and performing an error correction.

[Claim 4] It is the disk R/W control program characterized by being a disk R/W control program according to claim 1, dividing a storage top into a predetermined field, having an error rate measurement means to measure the read-out error rate and the rate of a seek error of data for each field of every, and performing verification processing after writing when this error rate of an R/W control means is larger than a predetermined value.

[Claim 5] The record medium with which data were written in using the disk R/W control program according to claim 1 and in which computer reading is possible.

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the data writing / read-out control program which heightens the error correction capacity at the time of read-out of data about the data writing / read-out control of a disk unit.

[0002]

[Description of the Prior Art] In stores, such as a floppy (trademark) disk and a magneto-optic disk, on a storage, as shown in drawing 15 , the track which records data on concentric circular is formed, each track is divided into the unit (sector) of two or more data, and data are recorded. For example, in the case of 540MB storage capacity, it is track spacing:1.1micrometer and about sector length:4mm in a magneto-optic disk with a diameter of 90mm. In the usual office environment, although there is dust to the diameter of several micrometers - about 10 micrometers, as shown in drawing 15 , when such dust adheres to a storage front face, a read-out error occurs. There are the following approaches as this cure against an error.

[0003] 1. When verification (verification) which collates the data which read data and were written in, and the read data is performed and right data cannot be read immediately after data writing, again, perform writing / read-out / verification, and check that data have been written in correctly.

2. As a cure against an error generated after writing, establish error detection / correction means (ECC means), and add and record an error detection correction sign for every sector. By this approach, about some (error correction capacity within the limits of an ECC means) errors generated at the time of data read-out, it corrects with an ECC means and outputs.

[0004] However, there is a problem shown below in these approaches respectively.

1. In order that the method of verifying immediately after data writing may perform writing of the same part, and read-out for verification at the time of data writing, write in, even if it is little data writing, and actual write-in time amount becomes long with the storage rotational delay for next verification processing as compared with net write-in time amount.

[0005] 2. When the error exceeding the error correction capacity of an ECC means occurs within one sector, it becomes a read-out error too. As an example of a cure of this problem, "JP,5-89609,A" is well-known. By the thing-mentioned-above well-known example, as shown in the table of drawing 16 , the sequence of bytes which extracted the cutting tool of the same location is generated from the data of the predetermined group who arranged and arranged the byte position of each data sector, and the sector which consisted of a data sector, a parity code generated to the generated sequence of bytes, or an error detection correction sign, i.e., a parity sector, is written in a storage as one parity group.

[0006] By doing in this way, even when the error which exceeds the error correction capacity of an ECC means with a certain sector occurs, the value which is each cutting tool who is the data sector which the error generated is counted backward from the value of the byte position of other data sectors of the same PATI group, and a parity sector concerned, and correction becomes possible. However, by the approach of a thing-mentioned-above well-known example, since the physical arrangement on the storage of the sector which constitutes one parity group is not taken into consideration, the sector which constitutes one parity group adjoins physically, and may be arranged.

[0007] However, when the dust to the diameter of several micrometers - about 10 micrometers adheres to a storage front face, this dust generates the error which cannot be corrected only with the error detection correction sign added to the data sector in this range ranging over the adjoining sector or the truck which adjoins at intervals of about 1 micrometer. Dust adheres to the conventional example which has arranged continuously the sector which constitutes one parity group into the sector, and drawing 17 shows the example which generated the error which cannot be corrected only with the error detection correction sign added to the sector. In this case, dust adheres ranging over one parity group's first sector, and the second sector, and even if the error which cannot be corrected with a first sector and the second sector occurs in coincidence and uses a parity sector, it becomes error correction impossible.

[0008] Drawing 18 shows the example to which dust adhered ranging over

two or more tracks of the storage of the same sector arrangement as drawing 17 . Also in this case, it becomes error correction impossible like the example of drawing 17 .

[0009]

[Problem(s) to be Solved by the Invention] This invention aims at making low the error probability of occurrence which cannot correct at the time of read-out of data, writing in by this and making verification processing at the time omissible.

[0010]

[Means for Solving the Problem] Invention according to claim 1 makes data with a predetermined number of L bytes a unit (sector). It is the disk R/W control program which the data sector of n predetermined numbers is managed [ control program ] as one group, and makes a computer perform the writing and read-out to a storage. The processing which generates m bytes of error detection correction sign to n bytes of data which extracted every 1 byte each of computer from the same group's data sector is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, It is made to function as an R/W control means which distributes n data sectors of the same group and m corresponding parity sectors so that the sector which belongs to the same parity group as one parity group may not adjoin physically mutually, and is written in a storage.

[0011] Invention according to claim 2 makes data with a predetermined number of L bytes a unit (sector). It is the disk R/W control unit which manages the data sector of n predetermined numbers as one group, and performs the writing and read-out to a storage. The processing which generates m bytes of error detection correction sign to n bytes of data extracted from the same group's data sector every 1 byte each is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, It is characterized by having the R/W control means which distributes n data sectors of the same group and m corresponding parity sectors so that the sector which belongs to the same parity group as one parity group may not adjoin physically mutually, and is written in a storage.

[0012] Even if the data error collected into the physical part by adhesion of

dust etc. by this occurs, the probability which the error which cannot be corrected concentrates on the same parity group's sector, and is generated becomes low. Therefore, the verification processing at the time of writing becomes omissible. A sector is arranged concentric circular and there is the approach of making it small whether it is equal to  $N$  in  $(n+m)$  as an approach the number of sectors around a track distributes the same parity group's sector physically to the storage of  $N$ . It can prevent being arranged by this in the same location of the track with which the same parity group's sector adjoins.

[0013] The approach of showing the same parity group's sector below as other approaches of distributing physically may be used. By  $N$  and relative-primes  $k$ , one parity group's sector is arranged for every  $k$  sector. That is, let sector number  $s=i, i+k, i+2k, \text{ and } i+3k \dots i+(n+m-1)k$  be one parity group.

[0014] Drawing 1 shows the example of sector arrangement at the time of being referred to as  $N=4$  and  $k=3$ . Here, the sector number is given to  $s_1$ - $s_{12}$  sequentially from inner circumference, and  $s_1, s_4, s_7$ , and  $s_{10}$  constitute the parity group 1. Invention according to claim 3 is a disk R/W control program which reads the data written in using the disk R/W control program according to claim 1, and an R/W control means is characterized by reading a parity sector and performing an error correction, when the error which cannot be corrected within a sector at the time of data sector read-out is detected.

[0015] That is, when there is no error in the read data sector, the error detection correction sign is added to the sector of the read data, and when an error correction is possible, read-out of a parity sector is omitted only from the contents. Therefore, unless the error which cannot be corrected arises, the time amount which data read-out takes is still the same as the case where a parity sector is not prepared. The more powerful error correction correspondence of the time of error generating which cannot be corrected is attained.

[0016] Invention according to claim 4 is a disk R/W control program according to claim 1, a storage top is divided into a predetermined field and it has an error rate measurement means to measure the read-out error rate and the rate of a seek error of data for each field of every, and when this error rate of

an R/W control means is larger than a predetermined value, it is characterized by performing verification processing after writing.

[0017] It becomes possible for this to update the cure against an error dynamically to the read-out error resulting from change of the surface state not only by a temporary error by adhesion of the foreign matter on the front face of a storage but fixing of a foreign matter etc., and to make low the probability of occurrence of the error which cannot be corrected.

[0018]

[Embodiment of the Invention] Drawing 2 shows the example of a configuration of the example 1 which copies the data of a hard disk (HDD) 1 to a magneto-optic disk (MO) 7 at a high speed. The data with which the R/W control means 5 directed data read-out of HDD1 to the buffer 2 with the directions from high order equipment etc., and read the buffer 2 from HDD1 are stored temporarily.

[0019] Whenever it initializes the parity buffer 3 and a buffer 2 reads the data for 1 sector from HDD1 according to the directions from the R/W control means 5, the parity generation means 4 generates new parity with reference to the read data, and updates the data of the parity buffer 3. The parity buffer 3 stores the parity data currently generated at the time, and when the number of parity guru-PU treated by one processing is set to g, it has a buffer for g sector. In addition, in order to use a buffer 2 also as a work area for creating parity data, it is desirable to have a capacity comparable as the parity buffer 3.

[0020] The R/W control means 5 writes out the data read into the buffer 2 from HDD1, and the data of the parity buffer 3 to MO7, and initializes a parity buffer (zero clear). The example of sector arrangement on the storage of the parity group data shown in drawing 1 according to an example 1 is realized, and processing of an example in which the contaminant shown here at drawing 6 adhered as  $n=3$  and  $m=1$  is explained. In this example, one parity sector which generated respectively three data sectors which constitute the parity group G1 from the data of each data sector to s1, s4, and s7 is written in s10.

[0021] Outline procedure is held to a buffer 2 by making into a parity group the predetermined data for 3 sectors read from 1.HDD1. 2. The parity generation



means 4 takes n bytes of exclusive OR (xor) to which 3 predetermined sectors correspond, generates a parity sector, and sends it to the parity buffer 3. 3. The R/W control means 5 writes respectively the data for 3 sectors of a buffer 2, and the generated parity sector in s1, s4, s7, and s10.

[0022] Even when the dust over two or more trucks as shown in drawing 6 adheres by this and it produces the data error of correction impossible with two or more sectors per sector, when the sector in which an error correction is impossible is seen into the parity group G1 who wrote in data, it is only s1 sector. Therefore, the error correction of s1 sector becomes possible using each cutting tool of s4, s7, and s10 sector.

[0023] The error rate measurement means 6 is read from the R/W control means 5, and calculates the error rate accompanying the R/W to MO7 from an error generating situation [ in / for the verification information at the time, and the positional information of the read data / reception and the location concerned ], and the parity generation means 4 updates the value (one parity group's magnitude) of n according to this error rate. For example, when an error rate is high, it is small in n, and when an error rate is low, n is set up greatly.

[0024] The calculated error rate is written out to MO7, it saves at the storage, this information is read at the time of storage insertion, and you may make it process. What was fixed for every MO disk is sufficient as several g of a parity group, and it may change by every zone of an MO disk. In this example, the number of the parity groups in a certain time shall be set to g, and the parity data of m sector shall be generated and given to the data of n sector.

[0025] The outline flow of the processing at the time of writing in data is shown in drawing 3 . The R/W control means 5 performs seeking (positioning) actuation according to the write request from high order equipment, and when a seek error occurs, it reruns it. Furthermore, the error rate measurement means 6 counts the number of errors of seek operation. The outline flow of the processing at the time of reading data is shown in drawing 4 . The error rate measurement means 6 counts the number of errors like the time of data writing.

[0026] The error rate measurement means 6 performs one error processing of

the degrees, when the occurrence frequency of the seek error in the above-mentioned seek operation or read-out actuation and a read-out error is memorized with the sector number and a read-out error rate becomes larger than a predetermined value.

(1) The R/W control means 5 performs verification after writing compulsorily.

[0027] (2) The R/W control means 5 carries out count operation of predetermined of the verification after writing, and when a read-out error is not lost, it performs shift processing of a sector.

(3) The parity generation means 4 is making [ many ] the error detection correction sign which makes small sector several n which constitutes one parity group, or is generated to one parity group, and heightens error correction capacity.

[0028] Above (1) It is comparatively simple processing, and since the difference with the conventional control is small, mounting is easy. (2) \*\* -- judge "since an error occurs frequently, even if it reruns, possibility of becoming an error is large in the location concerned", and change a sector.

(3) Extent to which a \*\* error rate becomes large expects it as the range which is about several times, and raises error correction capacity to extent corresponding to it.

[0029] In addition, he is for example, "informational digital transmission" Morikita Shuppan about an error detection correction sign. ISBN 4-627-82350-9, "computer basic lecture More powerful correction is attained by considering as the Reed Solomon code described by 18 coding-theory" Miyagawa \*\*\*\*\*, Shokodo, etc. Moreover, the parity generation means 4 can calculate m parity sectors by m independent formulas using the property "it can specify mostly with which sector the error has arisen by the error detection and correction of a sector unit." That is, even if it removes which m term, the value of a parity sector is calculated by m formulas which serve as a linearly independent mutually. By this, when an error arises with one of sectors, m relational expression which makes strange the value which is the sector can be built, and the value which is the sector which the error generated by solving this is calculated.

[0030] A parity sector is generated by the approach described above, a parity

sector is read at the time of read-out error generating, and an error correction becomes possible. The example of a pseudocode which performs error processing according to an error rate is shown in drawing 5 . Drawing 7 reads the data with which the real time nature from a digital video (DV) device etc. is demanded, and shows the example of a configuration of the example 2 written out to MO. Although the write-in time amount which should be guaranteed as the worst value may be exceeded if the verification / re-writing after writing occur when real time nature is required, this invention is applied, the verification after writing is omitted, and the above-mentioned possibility can be avoided.

[0031] In this example, incorporation of the input data from DV11 is considered as DMA processing, and a parity group's magnitude  $n$  is fixed. All make parallel processing easy and the high-speed processing of them is attained more. Moreover, the high logic of error correction capacity may be used for parity generation logic like the Reed Solomon code not only used as easy logic, such as xor, but  $m > 1$ .

[0032] Drawing 8 shows the internal configuration and the conceptual diagram of operation of the error rate measurement means 16 of an example 2, and explains data verification actuation when incorporation (writing to MO17) of the data from DV11 is completed. In drawing 8 , the error map 62 is the table showing the location which is the sector which the read-out error which cannot be corrected generates, or a bit map. The parity sector address 61 holds several  $g$  of the parity group when saving data, and sector several  $n$  which constitutes a parity group, and writes this value in MO17.

[0033] The R/W control means 15 reads the data written in immediately before from MO17, and stores them in a buffer 12. Generating of the error which cannot be corrected at the time of read-out at this time records that on the error map 62. When read-out of  $gx (n+m)$  sector is completed, the error correction means 63 starts. The error correction means 63 tries the error correction processing shown in drawing 9 , when the read-out error which cannot be corrected is recorded with reference to the error map 62.

[0034] Thus, the probability for the sector which cannot be read to remain can be made into a very small thing by processing. In addition, while establishing

the initiation directions means of activation, it indicates that it is under activation and you may make it start processing with directions of an operator about processing of drawing 8 .

[0035] Moreover, it may read, even if the sector which cannot be read correctly is found and it returns the sector by error correction processing by processing of drawing 8 , and it may become an error. In this case, a shift sector is usually assigned from a secondary defective list (SDL), and it is written in a shift sector. Since the shift sector field is used up, when a shift sector cannot be assigned, you may make it notify an operator as an error.

[0036] Drawing 10 applies this invention, and when an error rate is larger than a predetermined value, it shows the sample layout of the logical data in a disk of the file system of the example 3 equipped with parity sector field \*\*, a secondary parity field and secondary parity management \*\*, and error rate management domain \*\* as a means to decrease a predetermined number n. In an example 3, a parity sector is given for every cluster unit which consists of an n sector of a data area, i.e., a parity group. The number of parity sectors of parity sector field \*\* serves as 32000 - 64000 sector extent in general. A secondary parity sector field is a field of the parity sector given to the smaller unit, and since it is used according to the generating situation of an error, it has prepared secondary parity management \*\* which manages to which part the secondary parity sector was given. Error rate management domain \*\* holds the location of the error frequent occurrence field on a storage.

[0037] In this file system, in the case of the data writing to a disk, parity data are created per cluster and this is written in parity sector field \*\*. Furthermore, if it is the field where errors occur frequently with reference to secondary parity management \*\*, it will ask for the parity about a part for the first portion of a cluster, for example, and this will be written in a secondary parity sector field. This is equivalent to having set n to one half substantially.

[0038] The example of a pseudocode of secondary parity sector processing is shown in drawing 11 . Among drawing, if processing of \*\* is the cluster which should record, bitmap, i.e., the secondary parity sector, of 8KByte (=64Kbit), it will perform the bit map of '1', otherwise, '0'. \*\* Processing performs the array of structures of "the object location of a secondary parity sector, i.e., a "cluster

number" (2B yte) and "the location in a cluster", and the number of sectors" (4 bits each). If it is {1203, 4, 4}, making the parity for 4 sectors from the part of 4/16 from cluster 1203 head is shown.

[0039] \*\* Processing asks for the parity of the part to which it is pointed out with a secondary parity sector, i.e., \*\*. Data read-out operates as a in general conventional file system except for the following point. That is, when a read-out (1) error occurs, counting of the location and frequency is carried out, and it registers with the error rate Management Department.

(2) When the read-out error which cannot be corrected occurs (the usual file system notifies an error as it is), record the error source location as system information. An error is restorable from the parity information to which the software which started immediately after that gets to know the source location of an error, and corresponds by this.

[0040] In addition, although the FAT filesystem was assumed here, as long as it has the concept which corresponds per a cluster or allocation, the configuration same at other file SHISHITEMU can be performed. The example of a write-in processing flow of the cluster data of an example 3 is shown in drawing 12 . As an example 4, the example which applies this invention to optical-magnetic disc equipment as an own function of equipment is explained. The MO disk of 230MByte(s) - 640MByte has adopted the method called ZCLV. This divides the record section of a disk into 10-17 zones, and changes the number of sectors per truck for every zone. In inner circumference, there are few sectors per truck, and it increases, so that it goes to a periphery. For example, it consists of 18 zones in the MO disk of 540MByte(s). The innermost sections are 50 sectors per truck by 875 trucks, and the outermost part is 84 sectors per 875 trucks and truck.

[0041] Based on the number N of sectors per truck, it considers as one parity group every -3 sector  $k=N$  for every zone. That is, let the sector of sector number s be the parity group of watch  $(s \bmod 47)$  about the innermost section. One parity sector is prepared for every parity group, a parity value is calculated for every parity group of this at the time of data writing, and a parity sector is written in.

[0042] The conceptual diagram of sector arrangement of an example 4 is

shown in drawing 13 . In drawing, the line shows only the sector arranged as one parity group on a storage. For example, although the width of face of the part which carried out the hatch way is a part for about 20 micrometers, 20 [ i.e., ], trucks, even if the dust of 10 micrometerphi extent adheres here, the sector belonging to the same parity group stationed to the field of 10 micrometers of circumferencial directions for these ten trucks remains in less than one sector, and an error correction is possible for it.

[0043] Moreover, in an example 4, the field of a parity sector where the parity value about the sector of the same zone is saved for every zone is prepared. In the example of the innermost section, k is  $N-3=47$  sector. The magnitude of the parity group in the zone concerned is the total number of sectors /  $k=875 \times 50 / 47=981$ , and the number of parity sectors is set to 47. Furthermore, the field which manages the condition of each sector about each parity group is prepared. The tri-state of {release condition / written in/overwrite of was done} is managed about each sector. If there is 2-bit information for status management, it comes out enough and, for a certain reason, there should just be 1 sector, i.e., k status management sectors, for every parity group.

[0044] When giving the conventional disk and transposition, an initial defective list (PDL) is registered as if there were  $2k$  defective sectors at the time of a low-level format. The sector registered as this defective sector is used as a parity sector. Hereafter, when "sector number s" by which linear numbering was carried out for explanation is  $kxj+(i-1)$ , this sector shall belong to "the parity group i", and shall be managed with "the parity sector i" and the "status management sector i."

[0045] The data write-in procedure of an example 4 is shown in drawing 14 . For example, when writing in mass data, such as image data, the example of a user application program of operation is shown below.

1. Initialize the disk beforehand.
2. Estimate the magnitude of the data to write in (seeing allowances), secure the field of the part on a disk, and release a field if needed. About the estimated approach, it presumes, for example from the near time amount and the near bit rate of a video data.
3. Write in data serially.

4. Close a file.

5. Discharge a disk.

[0046] In connection with this, it processes as follows inside.

1. Initialize a status management sector and a parity sector.

2. Initialize the status management sector and parity sector of a zone to write in.

3. Update a status management sector according to writing, and update a parity sector. When the change of a zone occurs, these are written out to a disk.

4. Write out the parity sector and status management sector which are held to the buffer to a disk.

[0047] By upper processing, the contents of the status management sector do not show {finishing [ overwrite ]}. Thus, even if it writes in by adhesion of dust etc. and it is impossible to read data behind about the written-in data, as long as it stops in a parity group at 1 sector, restoring from the value of other sectors is possible. In addition, although here explained that package management of the one zone was carried out on account of explanation, k can be enlarged more or one parity group can be made small by subdividing a zone in the section the first portion and the second half.

[0048] As an example 5, it is good also as storage which shows n times of the sector length on a record medium, i.e., one parity group, as logical sector length. For example, in the store using the storage of 512Byte(s) or 2KByte(s), sector length can manage two or more sectors as 1 parity group, and can make what notifies sector length as for example, 16KByte(s) or 32KByte(s) to a host side. One or more parity sectors can be prepared for every 1 parity group of this, and this invention can be applied. Generally, the physical relationship of the data sector and parity sector which were summarized as a parity group is arbitrary. For example, you may set in the location which followed the sector summarized as a parity group, and only a parity sector may be summarized to the block for management etc.

[0049] It is good also as application software which backs up the data of a hard disk collectively as an example 6. For example, in backup software, the data of the collected amount are written in collectively. Moreover, in this

software, the time amount of backup, i.e., writing, is an important element. Original file management can be performed by such software. Moreover, original parity data can be generated for every backup file, and this can also be written in. For example, it is good, though the parity data for m sector are generated and this is written in, whenever the writing of backup becomes n sector.

[0050] As an example 7, it is good also as a file system, especially a file system accompanied by a data compression. For example, in the file system of FAT16 format, it has managed in the unit which calls the field of a disk a cluster. When disk capacity is 508MByte extent, the magnitude of a cluster is 8KByte(s), and if sector length is 512Byte(s), it will serve as 16 sectors. Therefore, in case a disk is formatted and a file system is built, the about 1/16 whole field is assigned as a parity sector. Henceforth, whenever it writes in a file, the data of a parity sector are generated for every cluster (since this write-in processing can be treated per cluster), and it writes in the field which assigned this separately.

[0051] By performing a data compression, in the file system which shows apparent disk capacity more greatly than physical disk capacity, the data of the magnitude of 8KByte - 32KByte extent are compressed as one unit, and it becomes possible to write this in a physical more small field, and to manage it. It is the disk R/W control program which the data sector of n predetermined numbers is managed [ control program ] as one group by making data with a predetermined number of L bytes into a unit (sector), and makes a computer perform the writing and read-out to a storage. (Additional remark 1) The processing which generates m bytes of error detection correction sign to n bytes of data which extracted every 1 byte each of computer from the same group's data sector is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, n data sectors of the same group and m corresponding parity sectors as one parity group The disk R/W control program for making it function as an R/W control means which distributes so that the sector belonging to the same parity group may not adjoin physically mutually, and is written in a storage.

[0052] It is the disk R/W control unit which manages the data sector of n



predetermined numbers as one group by making data with a predetermined number of L bytes into a unit (sector), and performs the writing and read-out to a storage. (Additional remark 2) The processing which generates m bytes of error detection correction sign to n bytes of data extracted from the same group's data sector every 1 byte each is repeated by L bytes of all data. A parity generation means to form m parity sectors which consist of L bytes, n data sectors of the same group and m corresponding parity sectors as one parity group The disk R/W control unit characterized by having the R/W control means which distributes so that the sector belonging to the same parity group may not adjoin physically mutually, and is written in a storage. [0053] (Additional remark 3) It is the disk R/W control program characterized by being the disk R/W control program which reads the data written in using the disk R/W control program according to claim 1, for an R/W control means reading a parity sector when the error which cannot be corrected within a sector at the time of data sector read-out is detected, and performing an error correction.

[0054] (Additional remark 4) It is the disk R/W control program characterized by being a disk R/W control program according to claim 1, dividing a storage top into a predetermined field, having an error rate measurement means to measure the read-out error rate and the rate of a seek error of data for each field of every, and performing verification processing after writing when this error rate of an R/W control means is larger than a predetermined value.

[0055] (Additional remark 5) The record medium with which data were written in using the disk R/W control program according to claim 1 and in which computer reading is possible.

It is a disk R/W control program according to claim 1. (Additional remark 6) A storage top is divided into a predetermined field and it has an error rate measurement means to measure the read-out error rate and the rate of a seek error of data for each field of every. A parity generation means It is the disk R/W control program which m/n is made to increase when this error rate is larger than a predetermined value, i.e., a predetermined number n is decreased or is characterized by making a predetermined number m increase.

[0056] (Additional remark 7) It is [ the description and ] a disk R/W control

program smoothly about being a disk R/W control program according to claim 1, and a sector being arranged concentric circular, an R/W control means distributing the same parity group's sector for every k sector by N and relative-primes k to the storage of N, and the number of sectors around a track writing in a storage.

[0057]

[Effect of the Invention] As explained above, according to this invention, it can consider as the storage which whose drawing speed is a high speed more, and is more stable using hardware the same as that of the storage of 1. former, or equivalent. In addition, the overhead for it is 1% of the memory capacity of the disk used as a parity sector, i.e., the memory capacity of all disks. - Several percent It is extent.

2. Error correction capacity increases, the verification after writing becomes omissible, and improvement in the speed of write-in processing of data can be realized. Moreover, substantial drawing speed is stabilized by omitting the verification after writing, and the drawing speed which can be guaranteed to a host or application also serves as a high speed. This enables it to extend the application of storage.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The example of sector arrangement

[Drawing 2] The example of a configuration of an example 1

[Drawing 3] The example of a data write-in processing flow of an example 1

[Drawing 4] The example of a data read-out processing flow of an example 1

[Drawing 5] The example of a pseudocode which performs error processing according to an error rate

[Drawing 6] The example of adhesion of sector arrangement of an example 1, and dust

[Drawing 7] The example of a configuration of an example 2

[Drawing 8] The internal configuration and the conceptual diagram of operation of an error rate measurement means of an example 2

[Drawing 9] The example of error correction processing

[Drawing 10] Sample layout of the logical data in the disk of an example 3

[Drawing 11] The example of a pseudocode of secondary parity sector processing

[Drawing 12] The example of a write-in processing flow of the cluster data of an example 3

[Drawing 13] The conceptual diagram of sector arrangement of an example 4

[Drawing 14] The data write-in procedure of an example 4

[Drawing 15] The truck and the example of a sector which record data on concentric circular

[Drawing 16] The example of parity sector generation

[Drawing 17] Example 1 in which dust adhered to the conventional example which has arranged the sector continuously

[Drawing 18] Example 2 in which dust adhered to the conventional example which has arranged the sector continuously

[Description of Notations]

c, d: The count of a seeking retry

g: Parity group number treated by one processing

G: Parity group number

k: Spacing which arranges the sector which constitutes one parity group

m: The number of parity sectors added to one parity group

n: The number of data sectors which constitutes one parity group

N: The number of sectors on 1 truck

L: The data length per sector

s: Sector number

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